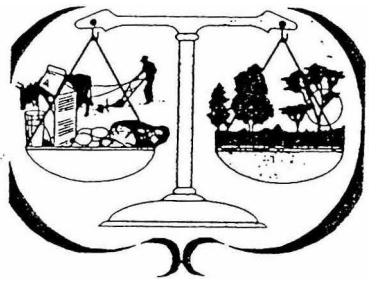
RAPPORT DE MISSION AUX PAYS-BAS

Du 16 au 20 Juin 1997

Conférence Internationale Elevage et Environnement Ede/Wageningen, Pays-Bas

Par Bernard TOUTAIN



Rapport N° 97-020 **Juin 1997**

CIRAD-EMVT
Département d'Elevage et de Médecine Vétérinaire du CIRAD
Campus International de Baillarguet
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MOTS CLES : Elevage-environnement - impact de l'élevage - systèmes pastoraux - Afrique aride et semi-aride

RESUME :

1) La conférence internationale sur l'élevage et l'environnement qui s'est déroulée à Ede du 16 au 20 juin est une étape importante dans la démarche entreprise depuis 1993 par la Banque mondiale, la FAO, l'USAID, la Communauté de l'Union européenne, et diverses structures officielles européennes de développement comme le Secrétariat d'Etat à la Coopération. Le but général de la démarche est de faire le point des impacts environnementaux des activités d'élevage au niveau mondial et de définir les orientations de politique de développement de l'élevage qui prennent en compte l'environnement, atténuent les effets négatifs et favorisent les effets positifs. La conférence de Ede constituait la présentation officielle à des représentants du Nord et du Sud des conclusions de l'étude entreprise et a lancé un débat sur les applications concrètes à mettre en oeuvre dans les différentes régions du monde, notamment dans les pays tropicaux.

Le CIRAD a participé activement à l'étude et, à ce titre, a souhaité s'associer aux débats aux côtés de ses interlocuteurs du Sud, notamment des pays francophones d'Afrique (Madagascar, Côte d'Ivoire, Sénégal, Tchad, Mali, Tunisie).

2) Les ateliers qui se sont tenus ont esquissé par régions les grandes lignes qu'il conviendrait de suivre pour un développement durable de l'élevage et le respect de l'environnement. Ces orientations sont riches d'enseignement pour le CIRAD dans l'optique des choix des domaines de recherche que l'on doit développer dans ce sens.

3) Propositions de coopération : on peut espérer que le CIRAD soit impliqué plus ou moins directement dans les étapes suivantes à la demande de l'Union européenne et de la Coopération française : ateliers régionaux, propositions de projets, réalisation de documents...

DÉROULEMENT DE LA CONFÉRENCE INTERNATIONALE

La conférence internationale sur l'élevage s'est tenue à Ede (Pays-Bas) du 16 au 20 juin 1997. Elle fut organisée par M. Arend Jan Nell, de l'IAC de Wageningen, à la demande et sur les directives de MM. Cees de Haan (Banque Mondiale[1]) et Henning Steinfeld (FAO) , suite aux décisions du *Steering Committee* de l'étude élevage environnement de septembre 1996 à Washington. Elle a rassemblé 110 personnes venant du monde entier, pour moitié des personnels d'organismes nationaux officiels, le reste étant partagé entre des universitaires, des membres d'ONG et des personnels d'organismes internationaux. Il y avait une bonne répartition des participants selon les régions du monde. Le secteur privé n'était pas présent.

Deux documents en anglais, fort bien présentés, ont été remis aux participants à leur arrivée. Il s'agit des conclusions synthétiques de l'étude résumant une vingtaine de rapports thématiques ou régionaux (dont 6 produits par le CIRAD). Voici leurs titres :

- *Livestock environment interactions. Finding the balance.*

- *Livestock environment interactions. Issues and options.*

J'ai apporté 30 exemplaires de la traduction en français du deuxième document, qui fut remise aux participants francophones, intitulée : *Interactions entre l'élevage et l'environnement. Problèmes et propositions.* Cette traduction fut très bien accueillie par les délégués francophones.[2]

Un document polycopié complémentaire était disponible. Il s'agissait des conclusions de la conférence électronique qui s'est tenue fin 1996 et début 1997 sur le sujet.

Il y avait traduction simultanée anglais, français et espagnol dans toutes les séances plénières.

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[1] Department of environmentally sustainable development.

[2] Les participants francophones ont fait remarquer qu'en tant que membres (et défenseurs) de la francophonie, ils étaient souvent isolés et marginalisés dans les réunions internationales, où l'anglais domine, et que la France négligeait trop souvent de faciliter et de défendre l'usage du français à ces occasions. Par exemple, les documents pratiques de la conférence étaient seulement en anglais.

Parmi les participants, on peut mentionner :

- des Français : Bernard Rey (délégation de l'UE au Nigéria), Christian Hoste (ISNAR, La Haye), Pierre Hiernaux (ILRI, ICRISAT, Niger),

- des Africains francophones : Mahamat Saleh (Directeur général au Ministère de l'élevage du Tchad), S. Mballo (Président de la commission environnement à l'Assemblée nationale du Sénégal), V. Rasoloarison (directeur national du projet "Tsingy de Bemaraha"), Minko Mi Ella (direction de l'élevage au Gabon), D. Diassana (direction nationale de l'aménagement et de l'équipement rural au Mali), Mamadou Taclé (chef de service à la direction des productions d'élevage de Côte d'Ivoire), M. Sanon (Burkina Faso), C. Campaoré (conseiller technique du Ministre délégué des ressources naturelles du Burkina Faso).

- des Africains du nord : M. Nourallah (IFAD, Rome), S. Smati (directeur d'un projet FIDA en Tunisie).

- des Africains de l'est : Mrs. H. Gebru (Ministère de l'agriculture d'Ethiopie), W. Masaga (OUA/IBAR, Kenya), H. Il Pun (directeur régional ILRI, Ethiopie).

- des Européens : Annette von Lossau (GTZ, division de production animale), Cary Hendy (NRI, chef du groupe élevage), Michael Dale (Commission de l'UE, DG8),

- des Américains : Harvey Blackburn (USDA), A. McCalla (Banque Mondiale), Mrs. J. Turk (USAID), D. Peden (IDRC, Canada), Bob Hart (directeur d'Inforum, USA), M. Woodford (UICN, Washington).

Vingt et une communications ont été présentées en séances plénières, tandis que **20 posters** étaient exposés. A noter la qualité du poster réalisé à Madagascar, résultat de journées préparatoires pluridisciplinaires sur le sujet, ce qui a incité les organisateurs à demander à V. Rasoloarison un exposé en séance plénière, lequel a été brillant et fut très applaudi.

Deux ateliers d'une demi-journée chacun se sont tenus. Les participants ont été répartis à chaque fois en 5 ou 6 sous ateliers, d'abord selon **les systèmes de production d'élevage** puis selon **les grandes régions géographiques**. J'ai été chargé de présider l'atelier sur les systèmes d'élevage au pâturage dans les régions arides et sub-arides. Je fus ensuite rapporteur de l'atelier sur l'Afrique au sud du Sahara, présidé par M. Mahamat Saleh[3] du Tchad. Les résultats des ateliers ont ensuite été exposés en séance plénière (pour ma part j'ai exposé les deux rapports en français).

Objectifs de la conférence

Cette réunion est **une étape** dans la démarche entreprise par des bailleurs de fonds depuis 1992 sur le développement durable de l'élevage et **la réduction des impacts des productions animales sur l'environnement**. Elle fait suite à l'étude entreprise par des spécialistes de

[3] Directeur général au Ministère de l'élevage

l'élevage, de l'économie rurale et de l'environnement. Le but assigné à cette conférence était de **divulguer les conclusions de l'étude aux pays développés comme aux pays en développement**, d'élargir la prise de conscience des problèmes environnementaux qui se posent et de proposer des dispositions pratiques. Il a donc été proposé de travailler sur les documents fournis, d'en faire l'analyse pour les critiquer ou les valider, puis d'orienter les actions à entreprendre ou à renforcer pour développer les effets positifs des pratiques d'élevage sur l'environnement et diminuer les effets négatifs.

Il a été demandé d'aborder surtout les questions de **politiques de développement durable** (référence en particulier au 4e chapitre du document) et de s'appuyer sur les expériences nationales, mais de passer ensuite à un niveau de réflexion plus global.

Déroulement de la conférence

Les exposés ont porté soit sur des aspects généraux, soit sur des études de cas, soit sur des thèmes particuliers de relation entre le bétail et des questions environnementales.

Louise Fresco, FAO, a parlé brillamment de sécurité alimentaire. Il n'y a pas de sécurité alimentaire sans élevage. Les quatre pistes pour limiter la dégradation des ressources sont : 1) diminuer la pauvreté, 2) aménager l'accès aux ressources, 3) réformer les politiques d'élevage, 4) poursuivre le progrès technique. Les moyens sont l'accroissement et la diffusion des connaissances en matière d'environnement et de technologie, la clarification des droits d'usage et de propriété, l'emploi des méthodes participatives en terme de développement.

Henning Steinfeld (FAO) a souligné que l'élevage est concentré là où l'habitat est dense. La tendance de la demande en produits animaux est croissante dans les pays en développement et décroissante dans les pays développés.

Cees de Haan (Banque Mondiale), parlant des systèmes d'élevage au pâturage, soumettait des propositions à la réflexion. Il défend le maintien de la mobilité dans les régions arides, l'amélioration des règles foncières ailleurs. Il pense qu'il est indispensable d'introduire la réalité des prix pour que s'appliquent pleinement les lois du marché et de l'économie. Il insiste sur le renforcement des institutions, avec notamment la mise en place de dispositifs d'urgence en cas de sécheresse. Il encourage le développement de l'information, l'enrichissement des bases de données, l'amélioration des infrastructures et le développement des technologies, notamment en régions tropicales humides et sub-humides (intensification) et en zones tempérées (extensification).

Peter Oram (IFPRI) constate qu'en Afrique du Nord et au Proche Orient le déficit de production par rapport à la demande s'accroît fortement, tant en céréales qu'en produits animaux. En élevage, il n'y a pas accroissement de la productivité mais seulement une pression croissante sur la ressource.

J. Slingenbergh (FAO) a fait une intéressante présentation de la géographie dans le monde. Il a montré des cartes réalisées à partir des données statistiques FAO (disponibles sur le web), comparant les densités animales aux conditions agroclimatiques ou aux populations humaines. Il n'y a pas de correspondance claire entre les zonages agro-écologiques et la répartition des animaux. Par contre il y a une certaine relation avec la densité humaine et il a fait apparaître des relations avec les systèmes de production. Il a mis au point un modèle complexe utilisant les images satellitales pour réaliser des études prédictives des capacités d'élevage.

Les actes de la conférence seront publiés.

Les ateliers avaient été très orientés au départ sur un déroulement commun de façon à traiter surtout du choix de politiques innovantes en élevage. Chaque sous-atelier regroupait une douzaine de participants, pendant une demi-journée.

Les conclusions font apparaître que les préoccupations sont d'abord la production de nourriture et l'obtention de revenus, avant les questions d'environnement. On doit aussi changer d'acteurs, en renforçant les responsabilités locales et en favorisant la décentralisation. La nécessité d'intensifier a été bien soulignée.

On note le besoin de structurer le secteur des productions d'élevage, de définir les rôles des différents acteurs, de s'assurer des implications sociales des actions environnementales pour favoriser une plus grande équité, de réduire les coûts environnementaux. Cela suppose le développement des technologies appropriées et l'instauration ou le renforcement des institutions.

Faire prendre conscience aux divers acteurs de la production des conséquences environnementales de l'élevage est l'une des étapes prioritaires de la démarche.

La marche à suivre proposée dans l'immédiat est la suivante :

- Faire connaître les conclusions de l'étude et diffuser les documents produits.

- S'assurer que l'on fait partout référence aux mêmes concepts.

- Aller de l'avant pour préciser au niveau régional les actions applicables, organiser des plates-formes nationales et régionales avec toutes les parties prenantes.

- Développer les échanges, les communications, une certaine convivialité sur ces questions au niveau régional.

- Tester les idées en conditions réelles.

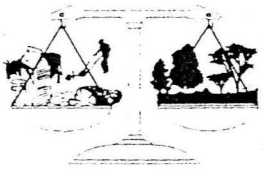
- Combler les lacunes (notamment celles qui ont été identifiées au cours des ateliers).

Le comité directeur ***(steering committee)*** compte actuellement une quinzaine de participants, tous motivés par l'enjeu, à savoir le développement écologiquement durable des productions animales. En séance restreinte après la conférence, il a décidé de poursuivre son action. Il entend en effet jouer un rôle catalytique d'organisation et d'animation au niveau international, et plus particulièrement à l'adresse des pays en développement. On souhaite aussi qu'il soit à l'origine de nouvelles initiatives. Il a défini au cours de cette séance les grandes lignes de la poursuite de son action, sur la base des conclusions de la conférence.

ANNEXE I

Compte-rendus succincts des ateliers sur les systèmes d'élevage
et de l'atelier sur l'Afrique francophone

INTERNATIONAL CONFERENCE 'LIVESTOCK AND THE ENVIRONMENT'
16 - 20 June 1997, Ede/Wageningen, the Netherlands



Workshop 1
Mixed Farming Systems (Developing Countries)

Gaps

- Mechanisms + driving forces
- Reduction of genetic diversity
- Fossil fuels as finite resource
- Omission of hard data
- Identification of indicators

Discussion Topics

- Consistent policy development
- Institutional development and interaction
- Informed decision making
- Technological change

Policy Development

- Address commonality (not exclusivity)
- Based on natural resource mobilization
- Develop understanding of evolutionary mechanisms
- Develop indicators to monitor the impact of policy

Institutional Development and Interaction

- Involve both formal and informal institutions
- Commitment to and by institutions is essential
- Encourage feedback between stakeholders and decision makers

Informed Decision Making

- Develop indicators and appropriate data bases on which decisions can be made
- The heterogenicity of Mixed Farming Systems requires more attention
- Decision makers at different levels require different forms of information
- Forward simulation modeling is a valuable tool for decision makers

- Support to fodder development/distribution
  - research + production of appropriate materials
  - multiplication + dissemination
  - clarify responsibility in govt services
- Support to drought power + mechanization services as appropriate

Mixed systems: next steps
Three priorities:
- Information + awareness
  monitoring, research, education
- Multi-sectoral planning
- Land-use planning for Agro-eco-system + FD development (systems understnading)

Means + roles:
- International/Regional/National Local Responsibilities
- International Actions + Support
  - World Bank - multi-sectoral planning
    - experience + funds
  - FAO - information, resource states, monitoring
  - ISNAR/CG - systems research, policy research, multi-system links
- Regional/National/Local
  discussion fora
  awareness - political, technical, popular
  planning participatory vision making
  multi-sectoral coordination
  environmental objectives

Workshop 3
Group on arid & semi arid grazing systems

General observations
- Regional differences
- Demand oriented

The need for consistent policies
What are consistent policies?
- Harmonized
- Appropriate
- Broad participation
- Holistic approach

Policy shortcomings
- Insufficient information

Reward: 'increase analytical skills and economic evaluation techniques at universities, government, and non-government institutions for environmental impact-assessment and related policy analysis'

Add new bullet: 'There is a need to increase support to farmers, and in particular to rural women, for making informed decisions on management of their resources. This is particularly important in arid and semi-arid regions because of the high risks of drought and the lack of infra-structure.

Why is institutional development important?

- Because of the erosion of traditional institutions, particularly in pastoral areas of arid and semi-arid regions, and the need to fill this vacuum through institutional reform at all levels
- To monitor compliance and enforcement of environmental regulations
- To encourage private sector investment in research and the adoption of improved technology in the arid and semi-arid regions.
- Bullet 2: last line: add 'resources' after 'water'. Delete 'through quote systems'
- Under 'Improvement of formal and informal institutions'. Clarify what is meant by 'the principal of subsidiarity', and if possible use a understandable substitute e.g. 'decentralization'
- Suggestion: add extra photographs. 'Encourage the establishment of community-based environmental associations and cooperatives'
- Add: 'there is a need to establish a regional and national networking system for environmental issues in arid and semi-arid regions'.

Workshop 4
Group on Mixed Farming Systems (Developed World)

Consistent policies

1. Must be: consistent, coherent, non-conflicting, effective
2. Compromise: population concerns vs environmental protection
3. Based on equity in access to natural resources and their benefits
4. Encourage technologies that maintain on improve environment + livestock quantity + quality
5. Be the "right" policy or mix to promote a balance of priorities
6. Consider local community requirements for sustainability
7. Prevent imposition of technology + other external policy that does not consider or reflect social, economic, and cultural reality
8. To avoid pitfalls in Agricultural Development (e.g. enforcement of duty on sugar)
9. Environment Impact Studies need for livestock policy - development (e.g. environment - soil degradation)

6. Development rate of organic farming
7. Assessment of sustainability aspects in the IS (energy)
8. Awareness raising among stakeholders
9. Effect of the IS on employment in developing countries
10. Animal welfare

Industrial System

- creates imbalances
- enjoys an unfair advantage as compared to other systems
- should not exist in its land detached form

Sustainability Aspects

Efficiency of IS at cost of enormous inputs of non-renewable energy:

- production
- transport
- inputs to keep the environment intact (waste management)

These energy needs are not emphasized sufficiently in the documents.

Nutrient Balancing at Watershed Level

Ecological speaking, at regional level (watershed, region, ?) These should be a balance between input and output of nutrients. IS working against such a balance.

- difficult
- should be stated aim
- IS zoning an approach to a solution

Feed Supply to the Industrial System

- Study refers in detail to waste disposal → not enough to problems related to feed sources
  - bought where cheapest
  - feed from food deficit areas
  - soil mining for feed grain production
- Social costs, including environmental costs should be incorporated into the costs of inputs (fertilizer, feed, etc.)

→ internalize externalities

Next Steps

Organize <u>workshops</u> to review L+E interactions in a well defined area (pilot approach)
Invite a broader audience

- knowledge level: animal scientists, environmentalists, sociologists, economists
- policy level: M. of Agriculture, M. of Environment, M. of Social Affairs

Workshop 7
Group on Humid Grazing

Humid grazing

What's next?

- Proceedings of electronic conference and this conference
- Donors to foster institutionalisation of those conclusions under a land management approach
- Transcription of the conclusions into practical tools for policy makers/donors agencies

Gaps (needed emphasis)

General

- Livestock vs alternative land use and environmental impact

Humid grazing systems

- Social inequities as one other driving force of migrates humid areas/forest margins
- A need to differentiate
  - land already deforested and grazed
  - land threatened of deforestation for livestock use

  Different policies required

Conclusions

Site specifics / recipes

p 33 report

- Discourage road constructions
- Establish protected areas
- Introduce taxation
- Promote research and extension

Other proposals

- Increase market opportunities
- Address poverty/equity in areas of origin of migrants (investments?)
- Policy for improved use of indigenous genetic resources
- Development of environmental education program
- Promotion of conflict resolution mechanisms

Atelier : systèmes d'élevage au pâturage en zones arides et semi-arides

Introduction

Les onze participants du groupe francophone sur les systèmes d'élevage au pâturage en zones arides et semi-arides ont retenu quatre éléments de stratégie prioritaires sur les 7 suggérés dans le document "Problèmes et propositions" (Issues and options").

1. Besoin d'une prise de décision en connaissance de cause (informed decision making)
2. Nécessité d'un développement institutionnel (institutional development)
3. Nécessité de mise en oeuvre de politiques cohérentes (consistent policies)
4. Nécessité de prix justes (to get prices right)

La hiérarchisation de différents besoins a fait apparaître que les trois premiers points sont nettement prioritaires par rapport aux autres.

Au cours des discussions, la question suivante s'est posée : est-ce que les éleveurs prennent des dispositions pour l'environnement, ne sont-ils pas éventuellement préoccupés par leurs besoins immédiats ? La perception n'est pas la même selon les pays, mais les éleveurs prennent des mesures environnementales quand ils savent qu'ils défendent la durabilité de leurs systèmes de production à long terme.

Les concepts d'environnement doivent être clairement définis et suffisamment expliqués pour que tous les intervenants (depuis les décideurs jusqu'aux utilisateurs) partagent la même vision. Il est nécessaire de sensibiliser les éleveurs aux questions d'environnement.

1. Ceci étant dit, voici les points essentiels concernant les besoins d'une prise de décision avisée :

La prise de décision avisée est l'élément fondamental de toute mise en oeuvre d'une politique cohérente. Cette prise de décision nécessite au préalable de disposer d'une base de données fiable (données physiques, sociales et socio-économiques) qui doivent être régulièrement actualisées.

Le processus de décision doit partir de la base et doit impliquer les personnes concernées à tous les niveaux. L'identification des problèmes doit mener à une prise de conscience tant au niveau des décideurs que des utilisateurs. L'approche participative a été soulignée comme un outil déterminant pour identifier les besoins et élaborer les décisions adaptées. Cette approche participative repose sur la contribution effective des intervenants à toutes les étapes d'élaboration et de réalisation des actions, et non se limiter à une simple consultation.

Une préoccupation a été exprimée vis-à-vis de certains modèles de développement venus de l'extérieur. Les programmes de développement doivent s'inscrire dans la stratégie spécifique de chaque pays.

2. En ce qui concerne le renforcement institutionnel, les points suivants ont été traités :

Il convient d'abord de renforcer les communautés de base,et cela dans un contexte juridique, pour qu'elles aient un statut légal. On s'appuie tant que cela est possible, sur les organisations traditionnelles car elles touchent aussi les éleveurs transhumants. On peut aussi créer des associations d'intérêt commun. Dans bien des cas, leur organisation est confiée à des ONG, dans la ligne des orientations politiques.

ATELIER AFRIQUE FRANCOPHONE

Trois niveaux de perception et de décision ont été retenus :
local, national, supra-national

1 - Au niveau local

Les acteurs à ce niveau sont principalement :

a) les communautés de base, ce qui inclut à ce niveau les représentants de l'administration,

b) les associations socio-professionnelles.

Doivent aussi être pris en compte dans les acteurs : les services techniques, les ONG, les leaders d'opinion.

Voici quelques propositions importantes retenues :

- promotion de l'organisation concertée de l'occupation (de l'utilisation) des terres,

- identification des problèmes environnementaux, notamment par les communautés de base,

- favoriser la création de groupements, les organiser de façon institutionnelle. Favoriser l'"auto-promotion", former les leaders des groupements pour qu'ils soient à même de bien les diriger et les gérer. Apporter une aide à la gestion.

- institutionnaliser les droits d'accès aux ressources pastorales. (La situation est variable d'un pays à l'autre).

- les prélèvements financiers pour l'sage des ressources et des services pastoraux doivent rester au niveau local (dispositions à inclure dans les statuts des communautés et associations).

- promouvoir des technologies appropriées au niveau des communautés. Valoriser ainsi des techniques déjà mise au point.

2 - Au niveau national

Les propositions suivantes s'adressent aux décideurs politiques et aux responsables des services nationaux notamment.

- Disposer de bases de données régulièrement actualisées, principalement pour le suivi des ressources pastorales et pour le recensement du cheptel. Le suivi de l'impact des actions et projets pour l'élevage a aussi été mentionné.

- Créer un comité technique interministériel permettant d'aborder les aspects environnementaux de l'élevage. Cette instance contribuera notamment à assurer une cohésion aux décisions et aux institutions.

- Développer l'institutionnalisation des droits d'usage communautaires là où les textes sont inexistants ou insuffisants.

- Elaborer un code pastoral, avec prise en compte des questions environnementales.

- Mettre en place un plan d'urgence en cas de crise ou de catastrophe naturelle (sécheresse).

- Développer la recherche sur les techniques d'élevage avec une attention particulière aux impacts environnementaux. Favoriser les technologies respectueuses de l'environnement.

- Réglementer les déchets des abattoirs. Développer les technologies appropriées pour le traitement des déchets d'abattoir.

3 - Au niveau régional (supra-national)

Il a été fait mention, d'une façon large, d'évaluer les implications environnementales, mais aussi sociales et économiques dans les accords bilatéraux et régionaux des sujets suivants :

- les déplacements des animaux d'un pays à l'autre,
- la santé animale,
- la commercialisation.

A noter que la traduction en français des documents produits par l'étude et résultant de ces journées est vivement souhaitée.

ANNEXE 2

Premières pages des communications disponibles[1]

[1] textes complets à l'UR Alfa

Livestock geography and land use

J. Slingenbergh(1) and W. Wint(2)

Abstract

Whilst still in the infancy, the development of geographic information systems (GIS) and remote sensing (RS) tools is paving the way for global land use monitoring. This paper provides a first, tentative description of livestock related land use.

Preliminary results indicate that, in most of the developing world, the distributions of man and his livestock are closely related. This association is particularly prominent in India, for large ruminants, and in South East Asia, for pigs and poultry. For example, it is estimated that in China some 95 percent of the human population is concentrated in 50 percent of the land area, the humid plus subhumid ecozones. Here, the average density of 260 persons per km square coincides with a livestock biomass of approximately 25 metric tonnes, out of which 36 percent, or 9 metric tonnes, is made up of live weight pigs plus poultry. The densily populated, better rainfall areas of China thus form the global epicentre of monogastric animals. It is in these areas also, where the highest animal protein production increase occurs. These local developments strongly affect the global statistics on animal agriculture; it is estimated that in the year 2010 poultry meat and pork will constitute about 70 percent of the developing world's total meat production.

With the progressive prominence of so-called land-detached, monogastric animal protein production in peri-urban environments in South East Asia, the question arises as to how to accommodate this development within the global agricultural landscape. While crop productivity gains may assist in overcoming the increased demand for cereals for livestock feed, the dynamic global animal production and associated change in land utilisation pattern interferes with a whole series of complex development issues, including poverty, environmental safety and emerging diseases' risk.

The progressive aggregation of people, crops and livestock in the developing countries requires clarification in order to come to grips with the complexity of interactions among economic, social and ecological processes. GIS and RS provide the tools for such undertaking.

Key words. Livestock geography, land use, animal agriculture, geographic information systems, monogastric animals, animal protein, Asia, China.

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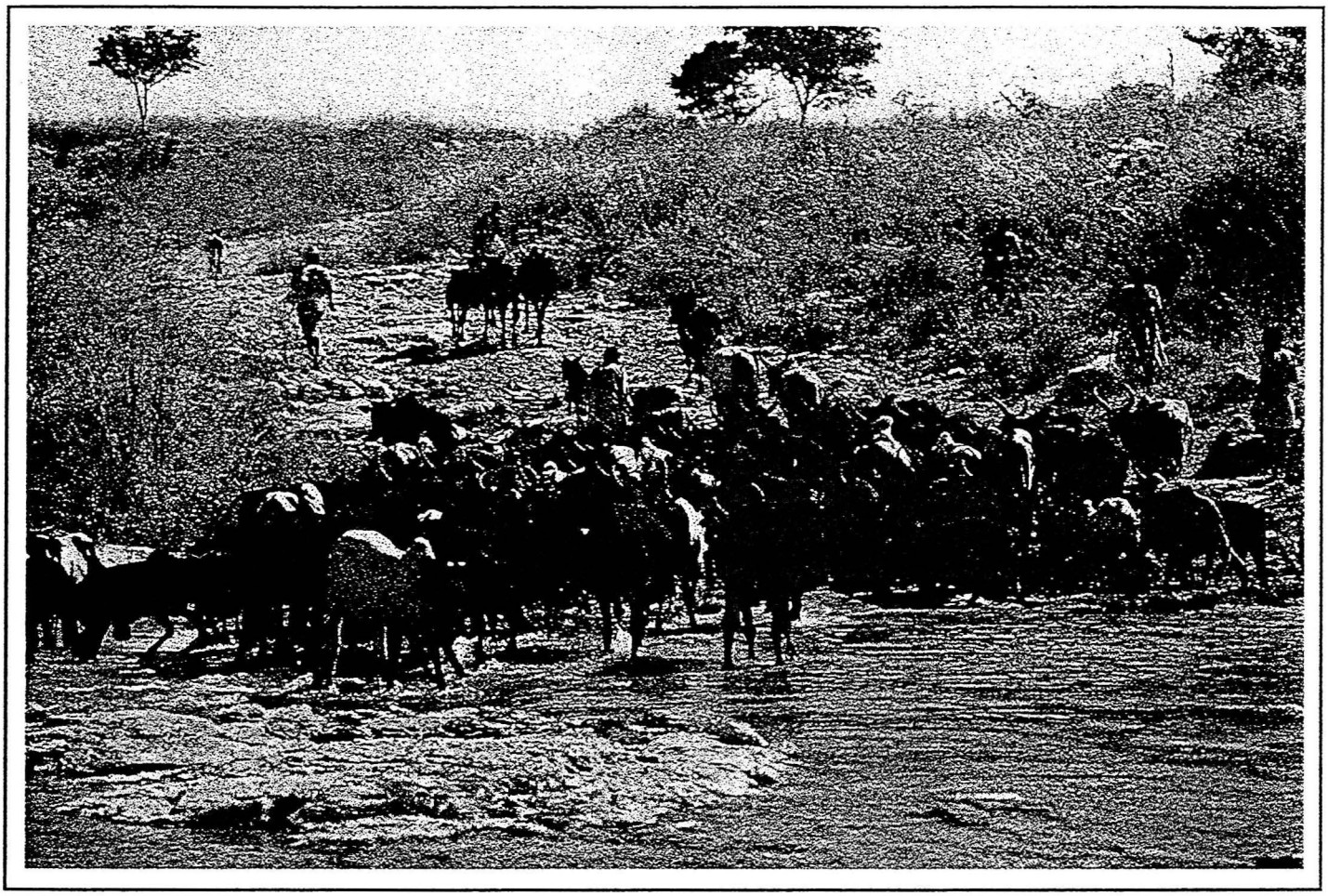
SOMMAIRE



L'ATELIER DE TRAVAIL SUR L'ELEVAGE ET L'ENVIRONNEMENT A MADAGASCAR

29 MAI 1997

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DIRECTION GENERALE
DES RESSOURCES ANIMALES

REPUBLIQUE DE COTE D'IVOIRE
UNION - DISCIPLINE - TRAVAIL

ELEVAGE ET ENVIRONNEMENT

Introduction

Une étude réalisée par le CIRAD - EMVT pour différentes institutions (Banque Mondiale, FED, FAC, FAO, GTZ, USAID,...) sur les interactions entre l'élevage et l'environnement a relevé la contribution de cette activité à la dégradation de l'environnement et proposé des éléments de stratégies pour résoudre ce problème.

La dégradation de l'environnement peut prendre diverses formes :
- dégradation du sol par le surpâturage ;
- pollution du sol et des eaux par les déjections animales et les déchets d'abattoirs ;
- réchauffement de la terre (effet de serre) ;
- affectation de la biodiversité du fait de l'expansion agricole.

L'élevage a aussi des effets bénéfiques sur l'environnement comme l'entretien de la fertilité des sols par la fumure et le labours (traction attelée), la valorisation de sous-produits agro-industriels qui seraient autrement brûlés ou simplement abandonnés dans des décharges.

La Côte d'Ivoire mène une politique d'intensification de son élevage, dans le cadre d'une gestion globale des ressources naturelles.

De plus, elle se dote d'une législation et d'une réglementation spécifique en matière de protection de l'environnement. En particulier, le décret n° 96-894 du 8 novembre 1996 détermine les règles et procédures applicables aux études relatives à l'impact environnemental des projets de développement. Ce décret soumet un certain nombre de projets (la plupart des projets d'élevage sont concernés) à l'étude d'impact environnemental, ainsi que les projets situés sur ou à proximité de zones à risques ou zones écologiquement sensibles.

En Côte d'Ivoire, la problématique des relations entre l'élevage et l'environnement se pose surtout en termes de :
- gestion de l'espace ;
- valorisation des sous-produits agro-industriels ;
- pollution organique ;
- promotion et préservation des races domestiques locales.

ET DU DEVELOPPEMENT RURAL

SECRÉTARIAT GÉNÉRAL

DIRECTION GÉNÉRALE

Direction de l'Elevage et des Industries Animales

B.P. 551 - LIBREVILLE

UNION - TRAVAIL - JUSTICE

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" ELEVAGE ET ENVIRONNEMENT "

16 - 20 JUIN 1997

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COMMUNICATION DU GABON

Antoine MINKO-MI-ELLA
DIRECTEUR ADJOINT DE L'ELEVAGE ET DES
INDUSTRIES ANIMALES

A Food Security Perspective to Livestock and the Environment

Louise O. Fresco
Director, Research, Extension and Training Division
FAO

Invited Paper
International Conference on Livestock and the Environment
Wageningen, 16 to 20 June, 1997

1. Introduction

Today, 850 million people suffer from hunger and malnutrition. In order to meet the minimum requirements of a growing population, food production will need to double over the next 30 years. Yet the natural resources required to produce this additional food - such as soil, water and biodiversity – are finite and vulnerable to degradation.

The Plan of Action, endorsed by the Heads of State and their governments at the World Food Summit in November 1996, assigned FAO a lead role in addressing food security worldwide. The Rome declaration identifies poverty and environmental degradation as the main causes of food insecurity. The Heads of State and their governments also recognized the need for urgent action to combat natural resource degradation, including desertification and erosion of biological diversity. Countries are determined to support all efforts to mobilize resources to reinforce national actions to implement sustainable food security policies. Poverty eradication and food security must be achieved without putting additional stress on natural resources. In many situations, food security and natural resource protection go together.

In this paper, I will attempt to discuss the interactions, both positive and negative, between livestock and the environment within a food security perspective, i.e. that of rural and urban poor in low-income food-deficit countries where the role of livestock is very different from that of middle or high income countries. Concern for the state of the environment and the degradation and dwindling of natural resources raises the following questions:

To what extent may the resource and environmental constraints impinge on the prospects for increasing food supplies and assuring access to food for all, the very essence of food security?

Can such progress be achieved while ensuring the gains made and can the potential for further gains be maintained for future generations, the very essence of sustainability?

What is the role of livestock in enhancing or compromising food security, now and in future?

DRAFT PAPER

An International Trade Perspective on Livestock and the Environment

Alexander McCalla and Cees de Haan[1]

Invited Paper
International Conference on Livestock and the Environment
Wageningen 16-20 June, 1997.

Over 100 million tons, or about one third of the volume of internationally traded agricultural commodities are livestock products or livestock feed. This international trade flow contains about 2-3 million tons plant nutrients, which are often shipped from nutrient deficit areas to already nutrient surplus areas, and have therefore potentially strong environmental effects. Depletion of soil fertility on one side of the globe, and nutrient loading at the other, both affecting land, water and bio-diversity, can be the results.

On the other hand, population growth, increasing income and rapid urbanization will cause over the next decades a strong growth in the demand for livestock products. A significant shift in the way milk and meat is produced, and hence how livestock affect the natural resource base can be the result. Changing trade patterns may play an important role in the direction and scope of these impacts.

In this paper, we will first give an overview of the role of feed and livestock products in international trade, then provide indications, how the recent World Trade Agreement may affect this trade, and indicate, how changing trade regimes and patterns might affect the impact of livestock on the environment, and what needs to be done next. Finally, we will go a little bit beyond the framework of this paper, and make some suggestions on what we feel should be the outcome of this Conference

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Price adjustments and the cattle sub-sector in central West Africa[1]
draft

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1 Introduction

Cattle produced in the Sahelian countries were traditionally supplied to domestic markets as well as to foreign markets in the more densely populated coastal areas of West Africa. In the so-called central West-African corridor, substantial cattle trade flows from Mali and Burkina Faso benefitted from the competitive advantages on the consumer markets in Côte d'Ivoire, Ghana and Togo in contrast to beef from world market sources. Since the mid 1970s, these advantages have gradually disappeared as a result of droughts in Sahelian countries, falling world market prices, and - since the mid 1980s - the increasing overvaluation of the CFA franc. Moreover, the European Union (EU) initiated an aggressive trade policy to deal with its meat surpluses in the early 1980s. When dairy quotas were introduced in 1984, European beef production peaked as a result of massive slaughter of dairy cows, and large quantities of beef receiving substantial export subsidies were dumped on the world market (Jadot and Rolland, 1996).

In 1994, the relative position of Sahelian livestock on the coastal West-African beef markets suddenly improved as a result of two major policy changes. Restitution payments (export subsidies) on beef to West Africa were reduced by 15 percent in June 1993 as a result of pressure from European non-governmental organizations (NGOs). More cuts were introduced in the months thereafter, which have resulted in a total reduction of restitution payments of about 30 percent as of early 1994. In addition, the CFA franc was devalued by 50 percent on 12 January 1994: the fixed exchange rate changed from 50 CFA franc to 100 CFA franc per French franc. These two sudden policy changes resulted in price shocks that had a large positive impact on the competitiveness of Sahelian cattle on the coastal markets in (francophone) West Africa, and as a result on cattle trade flows in the central West-African corridor. The effects on cattle production in the Sahel and on the utilization of rangelands are less directly observable.

The purpose of this paper is to examine in more detail the effects of the CFA franc devaluation and the reduction in EU restitution payments on cattle trade flows and coastal beef markets in central West Africa, and the implications for cattle production and rangelands utilization in the Sahel. Section 2 reviews the scattered evidence available on trade flows and on the coastal beef markets. The focus will be on Côte d'Ivoire and Ghana. Seventy percent of EU beef exports to West Africa went to these two countries during the period 1980-95. The effects on the beef market are likely to differ considerably between Côte d'Ivoire, which belongs to the franc zone, and Ghana, which nowadays has a floating exchange rate. The effects on cattle production and rangelands utilization in the Sahel are examined in Section 3. Because of limited data, the analysis is confined to a theoretical exposition. The inferences drawn are of a tentative nature and need to be examined empirically. The paper concludes with a summary of major findings.

---

[1] Comments on an earlier draft by P.E.J. Quarles van Ufford, University of Amsterdam, The netherlands, and the provision of data by A. de Jager, Agricultural Economics Research Institute (LEI-DLO), The Hague, The Netherlands, are gratefully acknowledged.

Netherlands Agricultural Environmental Policy; Lessons To Be Learned

Keynote address by Mr Johan de Leeuw, Director General of the Ministry of Agriculture, Nature Management and Fisheries of the Netherlands

Introduction

The Ministry of Agriculture, Nature Management and Fisheries is very pleased that the Conference Livestock and the Environment takes place in the Netherlands and that the International Agricultural Centre, which is part of the Ministry, has an important task in the organisation of the Conference and in the preparation of the study.
Dutch agriculture is characterised by a high productivity and intensiveness. A negative result of this is an output of polluting substances. With regard to livestock, this has the form of a mineral surplus which results in water and groundwater pollution.
On the other hand, livestock production has also positive environmental effects. It contributes to the closure of mineral cycles and it is a way to add value to by-products of agribusiness. In addition, it is a way to make good use of marshy areas, of which we have a lot in the Netherlands.
The first policy effort to control the mineral surplus in Dutch livestock husbandry is more than ten years old. We started to curb the rapid growth of manure production. Now, the policy aim is to arrive at a sustainable situation in the year 2010 in which mineral output in agriculture is geared to the carrying capacity of the environment. We have had to conclude that it is far from easy to control a mineral surplus caused by livestock production once it exists, in particular in areas in which intensive livestock production is subject to rapid growth. Maybe the Dutch experience can provide some clues for the development of general policy recommendations. It is for this reason that I entitled my speech 'Lessons To Be Learned'.

First, I will outline the development of environmental policy in the Netherlands. Then, I will look at the environmental problems caused by livestock production and the policies developed to abate it, and to conclude, I will sum up the lessons that can be learned from the Dutch situation.

Environmental Policy in the Netherlands

As in most countries, environmental policy is relatively new in the Netherlands. It started in 1971 with the creation of a separate environmental ministerial department. Since, environmental policy has become and important policy item.
In the first ten years, the emphasis was on the development of legislation and a system of environmental permits. At that stage, the legislation targeted pollution in the environmental compartments water, air and soil. Laws were drawn up and standards for environmental management were laid down. On the basis of these, environmental permits were granted. Enforcement is largely devolved to the provinces and municipalities.

With this legal approach of air, water and soil pollution, significant results have been achieved. However, drawbacks became apparent, too. By targeting air, water and soil separately, there is not only a multitude of rules, but they can also be inconsistent. Combined with the fact that different organisations are involved in the enforcement of the rules, this caused lengthy procedures and delays. The complicacy of the legislation led to enforcement problems, too.

These drawbacks necessitated a turn-around in environmental policy. A start was made with simplification and co-ordination of rules and procedures, and new policy lines were initiated, aimed at target groups, areas and products. The two basic preconditions for a successful long-term environmental policy were considered to be internalisation and integration.
Internalisation is the process where environmentally friendly behaviour becomes second nature. For this to happen, two things are required - a change in attitude and methods which integrate environmental considerations in management. To accomplish this, the main thing is to ensure involvement of groups in society in the development and implementation of policies.
Integration is understood as aiming at the realisation of cohesion and consistency between elements of the environmental policy and between the environmental policy and other policy areas, such as spatial planning, agriculture, traffic and transportation. Integration also implies a greater involvement of

Agroecosystem Health Management and Livestock

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The roles of livestock in agricultural economy, culture and ecology are complex and vary according to specific contexts around the world. Several authors, including those of the background report for this conference, have identified and discussed many of these roles, and it is not our intent to recount them (Steinfeld et al 1997). It is widely recognized in these discussions that livestock are not raised for their own sake, but to meet interacting, and sometimes conflicting, human nutritional, economic and environmental needs. For instance, as part of an IDRC-funded research project on human disease problems associated with intensive livestock slaughtering practices along the riverbanks in Kathmandu, it has become clear these cannot be seriously dealt with without also addressing issues of community empowerment, rural-urban migration, globalization of the economy, energy and water use for non-agriculturally-related activities, and changes in nutritional habits and culture.

Having said this, it is also clear that there is a paucity of conceptual and methodological tools to do the inter- and transdisciplinary work necessary to address such complex interactions. Agroecosystem health represents a theoretically and practically coherent approach to research and management of the full range of issues - from human nutrition and health to economic adaptability and ecological integrity - which must be addressed if workable policies and management strategies incorporating livestock are to be developed. Drawing on a diverse body of systems and management literature, and building on experience related to veterinary herd health management and human population health and healthy communities, agroecosystem health pulls together research and management into a seamless process of sustainable learning and adaptation.

Agroecosystem health - the concept

Agroecosystem health management comprises at least five (not necessarily linear) steps: 1) a description of the agroecosystem in systemic terms; 2) identification of decision-makers and/or stakeholders; 3) establishment of goals, that is, perceived attributes of a healthy system, operational objectives related to those goals at various scales and time horizons, and determination of measurable indicators which will give information about whether or not those objectives are being achieved; 4) identification and implementation of desirable and feasible changes, which often involves resolving conflicts among goals set by different decision-makers at different levels; and 5) monitoring of the selected indicators, and adapting to changing circumstances or unexpected or undesirable outcomes. This may mean revisiting the description of the

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Topic: Conference presentation

Draft - not to be quoted or published

LIVESTOCK AND WILDLIFE IN THE ENVIRONMENT - DIVERSITY IN PASTORAL ECOSYSTEMS OF EAST AFRICA

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June, 1997

Introduction:

In this presentation we have chosen to refer to 'livestock IN the environment' rather than 'livestock AND the environment', emphasising that livestock is not separate from, and dichotomous to, the environment, but rather one intrinsic component, and a tool for its management. Our paper presents a perspective on livestock and wildlife as components of environment in pastoral areas of East Africa. Using examples from Tanzania, Kenya and Uganda, it describes how the livestock component interacts, both positively and negatively, with other important elements of this environment, and especially with wildlife.

By 'wildlife' we mean the spectrum of living, non-domesticated species, both plant and animal, commonly referred to now as biodiversity. Yet despite this modern and comprehensive definition of wildlife, issues and conflicts between livestock and wildlife as land uses are frequently centered on ungulates and other large mammals, which share ecological niches with livestock species, and access to the range and vegetation which support all of them.

Some recent publications, and advocacy groups, stress that wildlife conservation has robbed pastoralists of a significant part of their traditional range. But with as the pressures of various other forms of land use increasing, particularly settled agriculture and subdivision of pastoral lands, pastoralists and wildlife managers in East Africa find themselves forced into an uneasy alliance. In general, it could be said that pastoralism and wildlife both have *first-order conflicts* (fundamental incompatibility) with intensive agriculture, whereas they only have *second order conflicts* (some constraints to compatibility) with each other. Given these conditions, a strategy of some pastoralist and conservation groups is to:

- combine the political and economic forces of pastoralism and wildlife conservation to restrict the expansion of agriculture into certain areas (including tracking the use of subsidies and land use policies leading to conversion of inappropriate lands from pastoral to agricultural use);

Livestock - Deforestation Links:

Policy Issues in the Western Brazilian Amazon

by

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and

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May 26, 1997
Version 2

Paper prepared for presentation at the conference "Livestock and the Environment" sponsored by, FAO, the World Bank and the International Agricultural Centre in the Netherlands. June 16-20, 1997. Wageningen.

WILDLIFE-LIVESTOCK INTERACTIONS IN KENYA

BY

W K OTTICHILO
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1.0 INTRODUCTION

This paper is structured into six parts. Part one provides a brief overview of the importance of the wildlife and livestock sectors in the Kenyan economy. Part two reviews recent trends in wildlife-livestock interaction at ranch and pastoral level and provides current views. Part three reviews past experiences regarding synergistic and competitive effects of wildlife-livestock combinations on plant and animal biodiversity conservation and on farmers and pastoralist income. In part four, discussions on operational issues related to wildlife, livestock interactions as regards to benefit sharing is given. Assessment of the main institutional and policy requirements to improve the synergy between livestock and wildlife is provided in paper five.

The last part of the paper provides overall conclusions and recommendations which are deemed suitable for incorporation into action plans and pilot operations.

2.0 IMPORTANCE OF WILDLIFE AND LIVESTOCK SECTORS IN THE KENYAN ECONOMY

Both wildlife and livestock sectors contribute significantly to the Kenyan economy. Tourism, which is one of the leading industries in Kenya is dependent mainly on wildlife viewing and photography. Due to abundant occurrence of diverse wildlife resources (mainly large wildlife herbivores), good climate, scenic landscapes etc, Kenya remains one of the most popular tourist destinations in Africa with about 6 per cent overseas visitors to the continent. The number of tourists visiting Kenya rose from 340,000 in 1972 to about 800,000 in 1992. The steady increase in the number of overseas visitors to the country has also witness an increase in the earnings from the industry. The Tourism sector is now the single leading foreign exchange earning sector in the country (GOK 1994). The industry earned the country K£27 million in 1972; and these rose significantly to K£2714 million in 1992 in nominal terms (GOK 1994). Since 1987, foreign exchange earning from the sector has been slightly more than the combined foreign-exchange earnings from coffee and tea, the traditional foreign-exchange earners. Currently, the industry earns about US$450 million annually. In addition, income from tourism related economic activities has become an important and reliable source of revenue to the Central Government and Local Authorities. The sector is thus of national

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FAO/World Bank/International Center in the Netherlands

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16 - 20 June, 1997

ENVIRONMENTAL PROGRAMS FOR THE RESTRUCTURING OF ANIMAL HUSBANDRY IN LITHUANIA

Dr. Arûnas Svitojus
The Secretary of the Ministry of Agriculture and Forestry of the Republic of Lithuania
Almonas Gutkauskas
Chief Ecologist of the Ministry of Agriculture and Forestry of the Republic of Lithuania

Abstract

Lithuania is a country where animal breeding is predominant in agriculture.

During the period of transition and before the planned accession to EU the extensive restructuring of Lithuanian agriculture is taking place. One of the most important processes in this way is the shift from natural resource consuming and polluting farming to sustainable and ecological agriculture which lead to important changes in the structure of farming.

At government level Lithuania first in the Central and Eastern Europe started to develop strategic guidelines, legislation and programs for the transition to ecological farming:

- strategic guidelines. The ecological restructuring starts in the most sensitive area - Karstic region of Northern Lithuania and shall be extended to the whole territory of Lithuania.
- legal basis. This basis confers high priority upon ecological farming and encourages it through the providing of government support for investment projects.
- national environmental pilot program "Tatula" which was developed by experts and approved by government in 1987-1993. The implementation started at first in the Karstic region of Northern Lithuania (Tatula is the name of small river in the Karstic region).
- National Agriculture Development Program.

The program "Tatula" was extended this year to the totality of the Lithuanian territory.

Industrial Livestock Production, Concentrate Feed Demand and Natural Resource Requirements in China

Ke Bingsheng*

The current and future food issues in China have aroused worldwide attention and concerns in the recent years. The future food issue in China is by nature a livestock problem. Expanding population, rising income and aspiration, coupled with rapid urbanization, will continuously enhance the livestock demand. This growth in demand calls for further intensification of natural resource uses, which will have increasingly significant economic, ecological and environmental impacts. As China is increasingly integrated with the global economy, that development trend in China will not only have significant implications for China herself, but also for the rest of the world. This paper will provide an overview and review on the driving forces for livestock demand, the industrialization of livestock production, the feed resources requirements and environmental implications in China.

1. Main factors driving demand for livestock products

Major influencing factors for livestock demand include population growth, per capita income growth, changes in population structure and marketing infrastructure as well as policies.

Population development

Population expansion has been one of the most important driving forces for demand of livestock products in China. The average annual population growth for the past decade was 1.4%. If this trend will continue into the next 35 years, China's population will then reach 2.0 billion by the year 2030. The Chinese government has set a very high population control goal, according which the total population should be 1.4 billion in 2010, 1.5 billion in 2020, and 1.6 billion in 2030 (IOSC, 1996). Whether this goal can be realized will have substantial impacts on livestock demand growth and hence the Chinese food balance in the future. The high population growth scenario implies 25% more food need compared with the low population growth scenario, with other things equal.

Population structure change(urbanization)

The urbanization process is another major factor driving livestock demand. The consumption level of meat and other livestock products in the urban households is twice to three times as much as that in the rural households. The share of urban population has risen from 23.7% in 1985 to 29.0% in 1995 (SSB, 1985-1995). If this trend will continue into the next 35 years, the urban share will be nearly 50% by 2030. This urbanization process is and will further generate increased livestock demand in China.

* China Agricultural University.

DRAFT OUTLINE

GLOBAL CONSULTATION ON BALANCING LIVESTOCK, ENVIRONMENT AND HUMAN NEEDS

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1. Introduction

Livestock provide essential commodities and services to the majority of the world's population. With increasing numbers of people, meat production is projected to increase from 200 million to 310 million tons per year by the year 2020. Although demand for livestock products is stagnating in developed countries, it is rapidly increasing elsewhere due to urbanization and associated shift in eating habits towards livestock products. In addition to providing meat, milk, eggs, hides and skins, livestock provide draught power and manure to enhance soil fertility. Livestock form an integral part of the social fabric for many peoples while they serve as a capital reserve available for hard times.

In spite of their growing global importance, increasingly livestock are being held responsible for many adverse effects on the environment. Loss of vegetative cover, reduced biodiversity, soil erosion and compaction, and excessive run-off often result from over-grazing. High concentrations of livestock contribute to contamination of ground water, eutrophication, and soil pollution. The processing of animal products especially in urban areas of developing countries generates waste materials creating disposal problems. Livestock can produce significant quantities of "green house" gases (e.g. methane) thereby possibly contributing to global warming. However, most criticism of livestock agriculture do not take into account the fact that negative effects are frequently related to underlying driving forces such as inappropriate land use policies, population pressures, rural poverty, insufficient ecological knowledge in tropical areas and inappropriate technology.

These trends and concerns were identified by several stakeholders, including representatives from several donor agencies. A study led by the World Bank, FAO and USAID (De Haan, Steinfeld and Balckburn, 1996) addressed those and the issues, according to the main livestock production system practiced in the various regions of the world.

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[1] *International Livestock Research Institute*
[2] *INFORUM*
[3] *FAO*
[4] *IDRC*
[5] *The World Bank*

ILRI, together with IDRC, World Bank and FAO, was requested to organize and conduct a global electronic conference and face to face consultations which would

MAINTAINING HARMONY: EQUITABLE AND EFFICIENT MEANS TO MINIMISE ADVERSE IMPACTS OF LIVESTOCK ON THE ENVIRONMENT

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Introduction

Livestock's impact on the environment is both positive and negative. Leaving ways to enhance positive effects to others, this paper focuses on reduction of adverse effects - the environmental costs of livestock production. Usefully, these adverse effects can be classified into *on-site effects* and *off-site effects*. Usually, the initial impact of on-site effects is on the productivity and quality of resources owned, controlled or used by livestock managers. The linkage between action and individual welfare is direct. In the case of off-site effects, however, the dominant adverse affect is on the welfare of other people, future generations and the environment in general.

Causes

A second typology - useful in unpacking the theme of this paper - is to identify the nature of the causes of the pressures that livestock can place on environmental processes and, though this, environmental values (Table 1). Some causes are *fundamental* to the structure of society and, because of this characteristic, involve many factors that require considerations that extend well beyond the traditional domain of livestock policy. Human population policies clearly fall into this domain. Limited by their status in the institutional arrangements that drive socio-economic activity, it can be difficult for livestock and resource policy makers to involve themselves in debates about the fundamental causes of actions that cause livestock to have adverse impacts on the environment. Hence, whilst not denying that, in theory, the most cost-effective way to reduce any adverse effect of livestock on the environment is to remove fundamental causes, this paper focuses on mechanisms to reduce *underlying* causes of the direct pressures that livestock place on the environment.

Design Principles

At the most general level, direct pressures can be reduced by prohibiting them or alternatively by reducing the underlying cause of the problem. The advantage of addressing the underlying cause of a problem is that when an underlying cause can be removed the incentive for managers to cause the problem to occur is removed and, little monitoring or enforcement is required. **As a general guideline, mechanisms that address underlying causes of problems are likely to be more cost-effective than those that address the symptom of the problem.** Thus, economists often recommend the introduction of policies like the Polluter Pays and User Pays Principles that make the costs of environmental damage transparent to livestock managers and the people who consume their products.

Less commonly discussed is the need to mix instruments, mechanisms and policies. In practice, the effectiveness of and need for each element will change through time as feedbacks occur and circumstances change.

One characteristic, not always acknowledged but of critical importance, is the degree of heterogeneity in mixed crop-livestock and extensive grazing systems. The responsiveness of people to each instrument varies according to factors like relative wealth, age, family needs and status. Moreover, the landscapes in which they operate are very heterogeneous and respond differently to changes in seasonal conditions. In aggregate, this means that, in any region, a suite of instruments